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A NEW DISEASE OF PLANTATION RUBBER IN MALAYA.

BY F. T. BROOKS.

For some months past the writer has had under observation a disease of rubber trees which has not hitherto been recorded in Malaya. The collar is the part of the tree principally affected. In this region the bark on one side of the tree dies and the wood beneath it becomes brown. Neighbouring lateral roots and the tap root below the collar are often affected in the same way and in advanced cases the disease spreads up the trunk to a height of 2 or 3 feet. If the diseased tissues are exposed, conspicuous black lines about $\frac{1}{32}$ inch in diameter are often seen near the limits of the affected parts though these lines are not invariably present. No external mycelium has been found but examination soon shews that the disease is caused by a fungus as hyphae are found in abundance along the junction of diseased and healthy tissues. When the disease was first seen it was evident that the causative fungus was neither *Fomes semitostus, Sphaerostilbe repens,* nor *Hymenochaete noxia,* but a considerable time elapsed before I found the fructifications of the fungus which is probably the cause of the disease. These fruit-bodies which have now been seen associated with the disease on four estates in different parts of the country are plate-like in form, greyish brown in colour except at the growing margin which is greenish, and are marked by an irregular and obscurely zoned surface. The substance of the fruit-body is brittle when mature. The plate-like fructification is several inches across when fully developed and the shape is irregular. It grows closely adpressed to the diseased collar of the tree or on an exposed lateral root. The general colour of the fructification is such that it can be easily overlooked for it is not unlike that of the

soil on many estates and the difficulty of distinguishing it is further enhanced in wet weather because the fructifications developing near the ground become covered with particles of soil. The upper surface is punctured with minute black dots scarcely visible to the naked eye. If the grey brown surface of the fructification is scratched a black layer is seen which is sometimes exposed here and there by the natural wearing away of the thin covering. The fruit-bodies are about an $\frac{1}{8}$ inch thick and if broken across shew in section a black zone immediately within the upper and lower surfaces, the intermediate substance being lighter in colour. In a white layer situated directly under the upper black zone perithecia are developed in which black spores are formed, eight in an ascus. The spores are spindle shaped and are somewhat inequilateral. The fungus is evidently one of the *Xylariaceae* and appears to be closely similar to and possibly identical with *Ustulina zonata*, but until specimens in herbaria have been examined it is impossible to identify it with certainty. *Ustulina zonata* commonly causes a root disease of tea in Ceylon and Petch has recently recorded it there as a root disease of plantation rubber also. In Ceylon *Ustulina zonata* develops on old stumps whence it passes to the roots of tea and rubber.

This disease which is by no means uncommon appears to affect chiefly old trees in this country and some of the finest specimens 14 to 16 years of age have succumbed to it. A few trees 5 to 6 years of age have also been attacked. The disease has been found both on flat and on undulating land.

Pure cultures of the fungus have been established on sterilised blocks of *Hevea* wood which become affected with black zones similar to those often found in trees affected by the disease in nature. The mycelium growing in pure culture is white at first but portions of it become densely aggregated and black as time proceeds. The black lines in the wood are due to this form of the mycelium producing dense stromatic masses in cells of certain parts of the wood and bark.

The presence of black lines in dead rubber wood is however of common occurrence and it is only when these black lines are associated with an affection of the collar and root system of a tree that the particular disease at present under consideration should be suspected. Many of the fungi belonging to the *Xylariaceae*, to which the fungus causing this disease belongs, are of common occurrence as saprophytes on dead branches and roots of rubber trees and two of these, *Nummularia pithodes* (B and Br) Petch

and a species of *Xylaria* have been found by the writer to produce black lines in the wood.

Pure cultures of the fungus have been used for inoculating the roots of 4 year old rubber trees and of young plants growing in pots. Eight of the former in which the fungus was inserted in wounds made in the roots with a scalpel shewed, six weeks after inoculation, that the fungus was spreading to an appreciable extent in the wood, but of six similar trees in which the fungus was placed in contact with unwounded roots only one root at the same date shewed signs of being affected. Of six pot plants which were inoculated three were killed by the fungus within seven weeks; in two of these the fungus was inserted in a wound in the root, in the other the wood block bearing the fungus was placed against an unwounded root. In these young plants the fungus permeated the tissues in the region of inoculation and though black lines had not appeared at the time of examination, aggregations of mycelium especially along the line of the cambium were evident.

This disease is by no means easy to distinguish in the young stages when there is some chance of dealing with it effectively yet it is important that this should be attempted as it is almost impossible to save the trees when the disease has made considerable progress. If the condition of the bark of a tree at the collar arouses suspicion it should be examined and if found to be diseased all affected tissues should be cut out and the exposed surfaces tarred; diseased roots should also be destroyed. If the fungus has penetrated so far into the tree that the tree would fall if all the affected tissues were excised the tree is doomed and efforts to save it will probably be useless; since however, the fungus spreads slowly the tree may be kept in tapping until the end. Such trees should be isolated by means of trenches and they should of course be cut out when they cease to yield latex in paying quantities. As the disease progresses the foliage becomes thin and the branches die back; if the fungus advances upwards from the collar, borers often affect the diseased parts as in the case of trees affected by *Sphaerostilbe repens.*

With the drastic thinning out that is now being practised on most estates it is important that once the number of trees per acre falls below about 80 to 100 every tree should be carefully watched for disease and care taken to treat it at an early stage, otherwise the yield from the plantation will gradually be seriously impoverished. This disease is particularly insidious and planters should be on their guard against it. The writer hopes to publish a fuller account of it at a later date

NEW MARKETS FOR BRITISH COLONIAL AND INDIAN COPRA.

We have pleasure in publishing the following circular issued by the new Technical Information Bureau established at the Imperial Institute.

The Bureau will be a special branch of the Scientific and Research Department of the Institute and will be staffed by experts who have had the advantage of experience in the work of that Department.

The present is a specially opportune time for the formation of such a Bureau since the paralysis of German and Austrian trade and industry opens up opportunities for the development of many industries in Great Britain and in the Colonies which have hitherto been monopolised by Germany.

The Director informs us that a number of British firms are now taking up the crushing of copra and in order to meet the demand thus created it is very desirable that these firms should be placed in communication with producers and merchants in the Colonies and India who have copra to dispose of. The Imperial Institute will be very glad to hear of such firms in the Federated Malay States.

Large quantities of copra have been exported during recent years from British Possessions to Germany and Austria-Hungary, and as this trade has totally ceased owing to the war it is necessary to consider the question of finding other markets for the produce.

The following table shows the imports of copra into Hamburg and Austria-Hungary during 1913 and will give some indication of the extent of the total trade and of the share of British Possessions. Hamburg is the chief centre of the German oil-seed crushing industry, and it is probable that the shipments of copra to that port practically represent the total German imports.

IMPORTS OF COPRA IN 1913 TO HAMBURG AND AUSTRIA-HUNGARY.

	Quantity metric tons (2204 lb.)
HAMBURG.	
Imports from all sources	230,395
„ „ British Possessions	124,434
AUSTRIA-HUNGARY.	
Imports from all sources	33,604
„ „ British Possessions	29,177

The details of the imports from the British Empire are as follows:—

IMPORTS OF COPRA IN 1913 TO HAMBURG AND AUSTRIA-HUNGARY FROM THE BRITISH EMPIRE.

	Hamburg. metric tons (2204 lb.)	Austria-Hungary. metric tons (2204 lb.)
United Kingdom	225	—
British Central and South America	195	—
British Africa	(not given)	774
British East Indies	112,341	22,104
Australia	10,653	
British South Sea Islands	1,020	
		6,299
	124,434	29,177

These figures are not quite accurate and complete. Some imports from British West Africa reach Hamburg but are not separately shown in the returns for that port. The imports from Australia to Austria-Hungary include 608 metric tons from British Australia and 5,691 metric tons described merely as from Australia, which may include some of the foreign possessions in the Pacific. The figures are however probably sufficiently accurate for the present purpose.

The quantity of British copra for which a new market must be found may therefore be taken as about 153,611 metric tons.

It seems likely that a considerable proportion of this can be taken by the United Kingdom. The copra imported into Germany and Austria-Hungary is used for the production of oil (coconut oil) and feeding cake (coconut cake). The quantity of coconut oil exported from Hamburg in 1913 amounted to 40,966 metric tons of which 30,236 metric tons was sent to the United Kingdom and 5,261 metric tons to Norway and Sweden, the next largest purchasers. Copra is already expressed for oil in the United Kingdom and coconut oil is made both in Ceylon and India. There appears to be no reason therefore why the coconut oil which is imported to the United Kingdom from Hamburg should come in this roundabout way. The oil might be expressed in Ceylon or India and shipped direct to the United Kingdom or the copra might be exported to the United Kingdom and treated here instead of in Hamburg.

Further, the Trade Returns for the United Kingdom show that in 1913 this country also imported about 18,600 metric tons of coconut oil from foreign countries other than Germany. The total imports of foreign coconut oil to the United Kingdom in 1913 therefore amounted to about 49,000 metric tons, corresponding to about 82,000 tons of copra.

It is moreover certain that from all these foreign countries which export coconut oil to the United Kingdom, and especially from Germany, considerable quantities of coconut oil also reach this country in the form of margarine, vegetable butter and prepared fats and foods of various kinds. No definite figures can be suggested for the amount received in this way.

It is clear from the foregoing statement that considerably more than half of the British copra hitherto exported to Germany and Austria-Hungary could be taken by the United Kingdom, either in the form of copra or coconut oil. Ceylon and India produce both copra and coconut oil so that these countries could probably divert their supplies in either form to the United Kingdom.

In addition to the possibility of finding a market in the United Kingdom there appears to be a considerable chance of the British Possessions securing a share of the French import trade in copra. In 1912 the total imports of copra into France were 153,506 metric tons. Of this total 19,691 metric tons came from British Possessions, and 10,321 metric tons from French Colonies. Of the remainder 43,422 metric tons came from the Dutch East Indies and 72,964 metric tons came from the Philippines. It ought to be possible for Ceylon, India, and the Federated Malay States to compete on favourable terms with the Dutch East Indies and the Philippines for this trade. There also seem to be considerable possibilities of developing an export trade in copra with Denmark, Scandinavia and Russia, and possibly with Holland.

In the case of the United States the imports of copra in 1913 amounted to 15,548 metric tons of which 10,674 metric tons came from the Philippines and the rest mainly from French, British and German Possessions in the Pacific. The imports of coconut oil to the United States amounted in 1913 to 22,915 metric tons of which about 18,000 metric tons came from Ceylon, India, the United Kingdom and Australia, and the rest chiefly from France, Germany and the Philippines.

L. L.-B.

MANURING EXPERIMENTS ON CASTLETON ESTATE, TELOK ANSON.

BY M. BARROWCLIFF, B. BUNTING, AND F. G. SPRING.

The experiments to be described were started in 1913 and the figures given represent the first year's growth after the treatment. At the time of the original measurement the trees were about three years old, and had an average girth of 11·98 inches. Each plot had an area of 2 acres and contained an average of 245 trees, but the numbers unfortunately were rather unequal. The object in view was to determine if possible which of the essential plant food constituents, nitrogen, potash, and phosphate, or combination of them, best served to stimulate the growth of the tree and subsequently the yield; whether the cheaper forms of nitrogen and phosphoric acid fertilisers are equally efficacious with the more expensive; and the relative effect of lime in the form of quicklime and limestone respectively.

A few months ago further experiments, on the effect of dynamiting, and a comparison between basic slag and powdered Christmas Island rock phosphate, were commenced also, and the results will be published when records for a complete year have been obtained.

The analysis of the soil, though published previously, may be reproduced. It is seen to be exceptionally heavy, containing a large preponderance of clay and fine silt particles, and to be well supplied with nitrogen, potash, and phosphoric acid.

Mechanical Analysis			Chemical Analysis
Coarse Sand	nil	Loss on ignition	12·6
Sand	2·4	Potash	·65
Silt	13·5	Phosphate	·051
Fine Silt	31·0	Lime	·18
Clay	50·4	Magnesia	·32
Humus	2·7	Nitrogen	·248
		"Available" Potash	·0096
		"Available" Phosphate	·0061
		Lime absorption factor	·4461
		= tons lime per foot-acre	5·9

It seems probable, from a consideration of the figures, that measures leading to a lightening and improvement of the texture

would be more likely to prove efficacious than applying artificial fertilisers.

The ratio of nitrogen: potash: phosphate in the complete fertilisers was 1 : 1 : 1, and was based on a recommendation made by Bamber for this soil.

Each mixture, whether complete or incomplete, was so adjusted that approximately an equal weight of these three constituents was applied to each plot.

Three controls, the average girth of whose trees was approximately the same as the average for the whole, distributed amongst the other plots, were taken.

The manuring scheme adopted was as follows:—

(*a*) 1 plot powdered, screened, limestone (3½ tons 2 acres)
(*b*) 1 „ lime
(*c*) 1 „ lime + nitrogen + phosphate
(*d*) 1 „ lime + nitrogen + potash
(*e*) 1 „ lime + potash + phosphate
(*f*) 1 „ nitrogen + potash + phosphate
(*g*) 5 plots lime + nitrogen + potash + phosphate
(*h*) 1 plot basic slag

In (*c*) (*f*), and 1 plot of (*g*) the nitrogen was derived from ammonium sulphate, the potash from potassium sulphate, and the phosphoric acid from concentrated superphosphate.

Of the remaining 4 (*g*) plots in one the nitrogen was partly derived from an organic source, groundnut cake and fish guano, and the phosphate also partly from fish guano; in the second nitrolim formed the source of nitrogen; in the third the phosphoric acid was added in the form of basic slag, and in the fourth of Perlis Guano.

This plot had more phosphate given to it than the remainder, as an amount of Perlis Guano equal in value to that of the basic slag was employed, and guano is a cheaper source of phosphoric acid than either slag or superphosphate.

Lime was applied at a uniform rate of 10 cwt. per acre, a quantity which, however, in view of the later investigations of one of us* is probably far too little to be effective.

* Agr. Bull. Nov. 1914 "The acidity of Malayan soils."

The following were the actual mixtures employed:—

A.	Baur's Patent Fish Guano (N 8% P_2O_5 8%) ..	300 lbs.
	Ground Nut Cake Meal (N 7%)	350 „
	Sulphate of Ammonia (N 20%)	100 „
	Concentrated Superphosphate (P_2O_5 42%) ..	100 „
	Sulphate of Potash (K_2O 50%) -..	150 „
	450 lbs. per acre, costing $20.00	
B.	Sulphate of Ammonia	350 lbs.
	Concentrated Superphosphate	160 „
	Sulphate of Potash	150 „
	300 lbs. per acre, costing $17.50	
C.	Nitrolim (N 18%)	380 lbs.
	Concentrated Superphosphate	160 „
	Sulphate of Potash	150 „
	300 lbs. per acre, costing $15.10	
D.	Sulphate of Ammonia	350 lbs.
	Basic Slag (P_2O_5 20%)	330 „
	Sulphate of Potash	150 „
	375 lbs. per acre, costing $17.30	
E.	Sulphate of Ammonia	350 lbs.
	Sulphate of Potash	150 „
	Perlis Guano (P_2O_5 18%)	440 „
	470 lbs. per acre, costing $17.50	
F.	Concentrated Superphosphate	160 lbs.
	Sulphate of Potash	150 „
	155 lbs. per acre, costing $7.20	
G.	Sulphate of Ammonia	350 lbs.
	Concentrated Superphosphate	160 „
	255 lbs. per acre, costing $15.10	
H.	Sulphate of Ammonia	350 lbs.
	Sulphate of Potash	150 „
	250 lbs. per acre, costing $16.00	

Initial measurements of the girths of the trees, 3 ft. from the ground, were made in April, 1913: lime, 10 cwt. per acre, was applied in June, 1913, and the manures in August of the same year. The trees were remeasured in April 1914.

The cost of application of the manures averaged $1.80 per acre. Lime, including its application, cost $10.40 per acre.

The following table shews the results obtained:—

No. of trees in plot.	Manure Applied.	Average Girth in inches April 1913.	Average Girth in inches April 1914.	Increase inches.
241	Lime + Mixture E (Perlis guano) ...	11.28	17.47	6.19
240	Lime + Mixture A (Bamber's formula)	11.43	17.54	6.11
259	Lime + Nitrogen + Phosphate (G) ...	12.06	18.12	6 06
259	Lime only	12.03	18 08	6.05
226	Lime + Nitrogen + Potash (H) ...	12.53	18.51	5.98
188	Basic Slag only	12.67	18.64	5.97
238	Control, no lime	10.92	16.75	5.83
215	„ „ „	13.11	18.83	5.72
222	„ „ „	12.00	17.68	5.68
253	Nitrogen + Potash + Phosphate (B) No lime	12.79	18.39	5.60
258	Lime + Nitrogen + Potash + Phosphate (B)	11.65	17.21	5.56
296	Lime + Mixture C. (Nitrolim) ...	12.90	18.46	5.56
207	Limestone...	11.64	17.13	5.49
252	Lime + Potash + Phosphate (F) ...	12.78	18.25	5.47
247	Lime + Mixture D (Basic Slag) ...	11.23	16.70	5.47

From the results it is seen that none of the various treatments have had any influence on the growth of the trees. The largest increase is only 7·8% greater than the average of the controls, whilst the smallest is 4·7% less, and it is a recognised maxim that in field trials not less than 10% should be considered as the margin of experimental error.

It should be pointed out however that the manures were applied only 2 months before the wet season set in, and this may have contributed partly to their apparent inactivity.

The treatment will be repeated in January and February 1915, when the trees become tappable, and the effect on the yield of latex recorded. The only modifications to be made will be that a definite quantity of fertiliser per tree and not per acre will be used, that the nitrogen in the basic slag mixture will be derived from nitrolim and not from ammonium sulphate, and that in the other mixtures in which the nitrogen was furnished by ammonium sulphate only, one half of it will be obtained from sodium nitrate.

THE THINNING OUT OF HEVEA RUBBER TREES.

BY THE HON. MR. E. B. SKINNER.

(A Paper Prepared for the Batavia Congress).

The question of thinning out is not the least important of the many important matters at present demanding the attention of those interested in the plantation rubber industry. The days are now past, I suppose, when new clearings are planted at $10' \times 10'$, but much careful study and the comparison of many statistics will be necessary before we can claim to have grasped thoroughly the best methods to pursue, in thinning out overcrowded trees.

On the Estates in which I am interested, it is now five years since we first devoted much attention to the question. At the beginning of 1909, thinning out was begun, and since then until the present moment the work has been carried on steadily, and the results compared, and the subject has never been allowed to fall into the background. During the past three years, our investigations have been enormously helped by the work of an analytical chemist, and in view of the excellent results obtained by him, we have lately added an agricultural chemist to our staff, whose work also should produce valuable results.

We had already long since seen enough to convince us of the great importance of this subject, and the more the question is studied, the more overwhelmingly important does the proper spacing of the trees appear to be. It may be urged that *Hevea brasiliensis* is normally a jungle tree, that is natural for it to be closely surrounded by dense vegetation, that to plant it in cultivated soil with abundance of light is to grow it in artificial conditions, and is running the risk of not obtaining the best results.

My answer to this is that we have practically no statistics or definite or reliable information as to the yield of Hevea rubber trees growing in the jungle, as to the duration of yield during the life of a tree, or as to the renewal of bark, and not very much as to the quality of the latex or the rubber as compared with the plantation product.

Until we have these, it seems to me that our best course is to rely on information obtained from sources within our ken, and all such information appears to point conclusively to the fact that *Hevea brasiliensis*, though a jungle tree, is happier and more profitable when widely, than when closely planted.

The two chief advantages to be gained by thinning out or by wide planting, are:

1. That the trees are healthier, yield more, and renew their bark quicker, and:

2. Great economies are effected because less labour is required to tap an equal area, and the yield per tree being better, less labour is required to produce an equal amount of rubber. Economies in tools and cups naturally follow.

Let us consider first the question of the health of the tree, yield of rubber, and renewal of bark.

The importance of sunlight to the health of a plant cannot be too strongly insisted on. The shape of branch and leaf of every green plant is dictated by the necessity of exposing as great a leaf surface as possible to the rays of the sun, and no green plant deprived of light can produce the chemical changes on which is proper supply of nutrition depends. The first effect of close planting on a tree is that its branches, as it grows larger and throws them wider, come into contact with those of its neighbours. Light is gradually shut off from the lower branches and from the base of the tree, and as the growth and health of any part of a plant are directly dependent on the supply of light, the lower branches gradually die and fall off, leaving rotting stubs sticking out from the main stem. The tree, in its efforts to obtain a sufficient supply of sunlight for its leaves, throws up long suckers, parallel to the main stem. After a time, as the tree grows taller and taller in its efforts to overtop its neighbours, and take not only its own, but also their supply of sunlight, all its good leaf and wide spreading branches are lost, and their place is taken by a closely packed bundle of suckers. These are very liable to be torn off by the wind, causing great damage, and often splitting and permanently injuring the main trunk of the tree. There is no room left for each sucker to bear a normal amount of leaf, so each is provided with a small tuft at the top, since nature's economy forbids the production of leaves where they receive no sun, and therefore can be of no use. The older a tree grows, the longer these suckers become, but though there is a greater length of branch and trunk to be provided with food, there is no room for an increasing head of leaf. Every tree is surrounded by neighbours who are growing taller as it grows, and all available space for leaves having been filled up while the trees were still young, the old trees with their great length of timber and branch are dependent upon the same amount of leaf as sufficed for them when small, but which is of course quite inadequate as age and growth increase. The result is obviously starvation.

This is the result where there is no special strain on the trees, as everyone who has walked through a closely planted beech wood or hazel grove knows. But the Para Rubber tree is called upon to do much more than supply itself with food, as ordinary trees do. It is constantly called upon to replace bark and latex removed by tapping. As this process goes on monthly and yearly, and the food supply of the tree remains the same owing to a small head of leaf, the only possible result is the gradual weakening of the tree, so that even on Estates where the quality of tapping has always received careful attention, where the tappers are well trained and no wounding has taken place from the first, a time arrives when the bark renewal becomes so poor, and the surface of the tree so uneven, that it is quite impossible to avoid wounding. Later on, if tapping is persisted in under the same conditions, the surface of the tree becomes covered with lumps and knobs, and no amount of care suffices to avoid serious damage to the tree in tapping. At the same time as this deterioration of bark is taking place the yield, instead of increasing yearly with the age of the tree, first becomes more or less stationary, and then actually decreases.

An instance of this may be given. On one Estate where the trees were planted at $14' \times 14'$, the yield was very good until about the sixth year of tapping. The trees were then a good deal overcrowded, and it became quite noticeable that the yield was falling off. At the same time, the renewed bark surface became uneven, and it was impossible to avoid wounding, in fact many of the trees in this area felt effects of tapping so much that they became permanently injured, and that in spite of the fact that the standard of tapping on the Estate was very good, and that wounding on normal bark was of rare occurrence. It was then decided to cut out the worst trees, in order to save the better ones, to stop tapping entirely on renewed bark, and to tap lightly on original bark above the bark that had been tapped previously. The trees were therefore reduced from about 200 to about 90 to the acre.

The result of this was that the yield per tree for the following year rose 80%, and the renewal of bark shewed signs of great improvement. It is now four years since this was done, and the bark renewal is so good that the trees are now fit to be tapped below, on the surface which had suffered so severely previously. The yield has also become normal, and gives promise of increasing yearly.

At the same time, it must be noticed that the renewal of bark, though satisfactory, has not been so rapid as it would have been had these favourable conditions been established earlier. The head

of leaf when cutting out was begun was very small, and it will still be some time before the trees produce branches and leaves enough to give the very best yield. Similar results were obtained on another area where the trees were originally planted at $10' \times 10'$. When tapping was started, there were about 300 trees to the acre. These were first reduced to 100, and afterwards were gradually thinned out until the whole number is now about 60 to the acre. It is interesting to note here that at its best this area yielded as much as over 900 lbs. per acre, but after reaching this point, the area rapidly shewed the results of close planting, and before thinning out began, the yield had dropped to below 400 lbs. per acre, and the trees shewed bad renewal of bark, low percentage of No. 1 rubber, and all the other effects of close planting. Other areas may be mentioned, planted originally at $20' \times 20'$, where the trees were not thinned out until they were about 9 years old. At this time the surface of the trees had not begun to suffer, but is was noticeable that the yield had ceased to increase, and had even begun to fall off, that the bark renewal was becoming slower and slower, and that the branches had dropped off and were being replaced by suckers. The growth also remained practically stationary. These trees were thinned out, leaving from 70 to 80 to the acre, according to local conditions.

Our experience in these cases, as in many others, has, then, convinced us that thinning out of closely planted areas leads surely and certainly to an increase in the yield and a quicker renewal of the bark.

We may now proceed to consider the second great advantage claimed for a widely planted, or severely thinned out Estate, over a closely planted one, namely:

The greater economy with which it can be worked.

First, let me emphasize again what I have already pointed out, that the yield from say an acre of widely planted trees will be as great as, or greater than that from an acre of closely planted trees. Bearing this fact in mind, it may be asserted in the first place that fewer coolies will be required for tapping, since fewer trees will have to be tapped to produce, say, one pound of rubber. I have heard it said by the critics of thinning out that a cooly who taps an acre has to cover an acre, and that if his task is, say, 300 trees, he will get through it quicker if they are all on one acre, than if they are on several. In fact, however, it is not the actual area which the trees stand which counts, but the number of rows up and down which a cooly has to walk, and it is obvious that there must be more rows of trees in an acre bearing 300 trees than in an

acre bearing, say, 70 trees. The cooly's task is not proportionately increased if he has to cover 4 acres widely planted, as he has fewer rows to walk up and down.

In view of the excellent results obtained by contract or bonus tapping, we may also look at the matter in another way. On a widely planted Estate, though a cooly has to take a few extra steps between each two trees, he has to make fewer cuts to obtain his given amount of rubber, he has fewer spouts to clean, fewer cups to wash, fewer cups to put into position for the collection of latex, and fewer shavings to collect. It follows, then, that he may be expected to bring in more rubber as a daily task from a widely planted Estate than from a closely planted one, and hence there is also a great saving in the cost of collection. We may take it that fewer coolies are required to produce the same amount of rubber where the trees are widely spaced, and fewer coolies means a smaller wages bill, and a lower f. o. b. cost.

Other economies also result. On the basis of an acre bearing say 70 trees yielding as much as one bearing say 150 to 200 trees, an enormous saving is effected in the outlay on cups and spouts. This is so patent that we need not go into calculations of the cost of one cup or one spout, and multiply by 70 or 200 to shew exactly what is saved. It is quite certain that a great deal of expense is saved on spouts and cups, meaning an appreciable amount per pound of rubber.

Under present market conditions the proportion of No. 1 rubber to the other grades is a very important question. A few trees produce a large quantity of rubber, and fewer spouts are required, so the quantity of scrap rubber is reduced. The same is true of cup washings and shavings, since fewer cuts and cups are required to collect the same quantity of rubber. Hence a higher proportion of No. 1 rubber to the total crop, and a larger average priced realised.

It must certainly have fallen within the experience of some planters that weeding has become more expensive where an area has been freshly thinned out. More light penetrates to the ground, and in consequence more seeds germinate, and a larger crop of weeds is the result. We have always found that the cost of weeding has gone up after thinning out has taken place, but we have never found this effect to be other than temporary. On a well weeded Estate, such a flush of weeds is very easily controlled, and if the newly grown weeds are not allowed to seed, the cost should not increase for more than one month or so, after which the increased spread of the branches produces shade, and hinders the

growth of the weeds. Where the weeds are not removed the mischief is, of course, more serious, though even here the rapidly increasing spread of the branches of the remaining trees would tend to check the weeds in time.

We may say then, that by thinning out, fewer coolies are required to produce each pound of rubber, fewer cups and spouts are used, less low grade rubber is produced, and expenses (except sometimes temporarily for weeding) are substantially reduced in many directions. From our experience, it seems undoubted that the latex of well renewed bark from widely spaced trees yields a much higher percentage of No. 1 rubber than the latex from closely planted trees. From the evidence we have been able to collect so far, the difference appears to amount to not less than 10%.

Having now considered the effects of thinning out, *we may turn to the actual process of cutting out the trees.*

There is a prejudice on some Estates, in favour of cutting out geometrically, so as not to interfere with the regular arrangement of the trees. Something may be said for this method, and in the case of untapped trees it may be the best, but, to my mind, that of cutting out by selection is the only sound one. Even cutting out by selection may, however, be based on two different principles, for trees may be judged by their appearance or by their yield. The presence of excrescences on the bark, a poor looking head, interlocking of the branches with neighbouring well grown trees, a bad arrangement of branches making a tree liable to be split by winds, are better reasons for removal than the position of a tree in the row. I think, however, that generally the prime factor in deciding the fate of any given tree should undoubtedly be its yield. This can be ascertained roughly by careful observation on the part of the Assistants in charge of the tapping, with the cooperation of the tapping coolies, but with greater experience in the matter, convenient methods of selecting trees by their yields will, we hope, be worked out. Although selection, however, should be primarily based on yield, general considerations of spacing should not be entirely neglected when thinning out is undertaken. When all the very poor yielders on the one hand, and all the very good yielders on the other hand have been picked out, there will always remain a mass of mediocre trees which can probably be most conveniently dealt with by general considerations, at all events until more exact methods of selection have been worked out, and until such questions as the inconstancy of yield from certain trees have been examined. The question of the simplest and most accurate method of ascertaining the yield of individual trees for purposes of thin-

ning out is an important one, which ought to receive a good deal of consideration in the future.

Of course the best method of thinning out for one area may not necessarily be the best for another. Take as examples an evenly grown young clearing that is to be thinned out before it comes into tapping. In such an area selection by appearance and yield would not be so applicable, and the method of cutting out geometrically would obviously be the best to apply. Compare this with, say, an old area on which the trees had been planted at $10' \times 10'$, and on which they had been too severely pruned. It is obvious that in this, as in all other planting questions, common sense must come to the aid of the rule of thumb, and a knowledge of the experience of other Estates on the same question is likely to be invaluable.

Another interesting question is whether trees should be cut out straight away, or should first be pollarded and tapped till they cease to yield. When thinning out first began to claim attention, the natural anxiety and slight distrust of its effect on the yield per acre, felt even by its most enthusiastic advocates, led to the desire to get as much as possible out of the trees before they were removed. They were therefore generally cut off at about 8 feet from the ground, and tapped for several months until they ceased to yield. This method is now I think, being superseded by that of cutting straight out, and, I think, rightly, for the following reasons:

1. It is cheaper to have the tree cut out once and for all, than to have it first cut off at 8 feet, and later on cut out completely.

2. The yield from a pollarded tree, deprived of all its food producing branches, and dependent only on the tuft it throws out at the end of a sucker, and overshadowed by its neighbours, must necessarily decrease very rapidly as the tree quickly becomes exhausted. In most cases the yield, even at best, barely covers the cost of tapping, collection, etc.

3. The yield of the remaining trees is now proved to increase so rapidly, in areas where thinning out is done in good time, as to more than compensate for the loss of yield from the pollards, and the supply of food in the ground is left for the good yielders, instead of being partially appropriated by the poor yielding pollards.

4. Where pollards are tapped, it is almost inevitable that both assistants and tappers, knowing that the pollards will soon be cut out, should become careless about the standard of work done

on them. I have known the whole standard of work on an Estate to deteriorate temporarily, owing to bad work allowed on pollards.

I think, therefore, that it is the better policy to cut out the trees to be thinned out at once, rather than to pollard and tap them first.

The next question I will consider is:

When should thinning out begin, and at what pace should it proceed.

As a general rule, I think that some form of planting should be adopted which will give approximately 100 trees to the acre. Of these 100 trees planted, probably only 60 or 70 trees will be large enough to tap when tapping begins. This means that a good many of the trees are backward and are therefore never likely to do any good, and in such a case it would be advisable, in my opinion, to have them reduced by selection, by the time tapping begins, to about 80 to the acre. After this, careful observation of the yield and general conditions should continue, and the cutting out of individual trees should go on from time to time.

On a thickly planted Estate, the rate at which thinning out should proceed depends entirely on the condition of the trees, and their bark. If the bark renewal is already very bad, and the yield is also very poor, the best course, in my opinion, is undoubtedly to cut out at once to about 70 to the acre. If, however, the trees are only beginning to shew signs of overcrowding, such as loss of branches and a tendency to poor bark renewal, it would possibly be better to reduce them first to 80 or 90 to the acre, and afterwards, by careful selection, to a smaller number. What the smallest number per acre may be, to which under any given circumstances it might be advisable to reduce the trees, is a matter for the future to decide.

In discussing the question of the economies effected by wide planting, I said that the yield per acre from a widely planted Estate is as great as, or greater than, from a similar area closely planted. This does not apply to its full extent to the first two years of tapping. During these years, although the branches may already have been interlocked, the full bad effects of close planting have not yet been felt, and therefore the yield may be greater than from a more widely spaced area. But a high yield in the first and second years, owing to close planting, inevitably endangers the health and yield of the trees in say the seventh and subsequent years, when the Estate should normally be increasing annually in value, owing to the yearly increase in yield, and the possibility of effecting great economies in working.

Even if thinning out began in the second year of tapping, in well grown areas, the remaining trees would almost certainly have suffered already, and their yield in future years would have been injuriously effected.

I think, therefore, that it is infinitely the better policy to sacrifice a small increase in the crop in the first and second years, for the sake of the subsequent prosperity of the Estate. The large question of the amount of working Capital required enters in here, for under-capitalised Estates may, of course, urgently require the extra crop during the first and second years' tapping, but the subject of capitalisation is hardly relevant to our present discussion.

METHODS AND MATERIALS FOR THE CONTROL OF INSECT PESTS.

PART 1.

BY P. B. RICHARDS.

Residents in the East are all more or less affected by noxious insects. The annual damage caused by insects is enormous, and is not confined to any particular class of property. Almost every kind of possession is subject to their ravages, rubber estates, padi fields, garden plants, buildings, clothing, food, tobacco, books; indeed it is difficult to suggest any kind of property which may not be more or less injured by insects.

How to prevent these injuries is the problem which Entomologists all over the world have attempted, and are attempting to solve. The results of their efforts are recorded in literature which is voluminous, scattered, and not easily accessible to the public. It may therefore be helpful to give, in a series of monthly papers, general advice upon the preparation and use of poisons, fumigants, deterrent mixtures and mechanical contrivances applicable to the treatment of the commoner insect pests of Malaya.

It is hardly necessary to point out that it will not be possible to cover the whole field of insect treatment in the proposed series of articles. Cases of attack by a common pest are frequently presented which require individual consideration and special treatment; certain pests, also, require more detailed consideration than can be accorded them here. It is hoped, however, to indicate simple methods which may be applied to the control of normal attacks by

the majority of the common insects, including those household pests which add to the burden of housekeeping in the East.

In countries not subjected to man's interference, natural methods of control operate sufficiently well to prevent that abnormal proliferation of a noxious insect which constitutes a pest. Important factors in the natural control of insects are the action of climate, insectivorous birds, predatory insects, parasitic insects and fungi, and the scattered arrangement of food plants. When man interferes with nature's arrangement, destroying the mixed vegetation and planting in its place large blocks of one species of plants, some or all of these natural factors are affected. One or more of the insects deprived of their regular food plant will find a satisfactory substitute in the new vegetation over which it spreads and becomes a pest.

The importation of an injurious insect, or even of one which is not known to do great damage in its native home, may also give rise to a pest even in virgin land or in an old-established agricultural country where the balance of nature has re-adjusted itself. Relieved from the controlling influence of its parasitic enemies, and finding in its new habitat a food plant upon which it thrives, its rate of increase may be appalling.

Measures are now applied over almost the whole world to prevent the importation, retard the spread, or decrease the numbers of a pest, or to minimise the damage done by it. Such measures may be classified roughly under four heads.

1. Legislative.
2. Cultural.
3. Chemical.
4. Mechanical.

Legislative measures apply generally to the importation and transportation of plants which may harbour a pest. They will not be further considered in these articles.

Cultural measures are of great importance, especially to countries growing annual crops. It has been said of the ravages of the Hessian fly in the wheat crops of North America, that "four fifths of its injuries may be prevented by a better system of agriculture." Crop rotation, the removal of all crop remnants as, for instance, stubble after harvest, the destruction of weeds or rubbish, the removal of self sown plants between seasons, as well as the growth of strong plants or of immune varieties, and the selection of crops suitable to the climate and soil, are important points in this connection. An alteration, also, in the time of planting

and harvest is occasionally successful against pests of cereals which do not yield to other treatment. It will readily be seen that cultural measures are applicable to crops which do not lend themselves, either on account of their nature or of their value, to chemical or mechanical treatment. Indeed for most of the crops grown by native inhabitants of the tropics, cultivation methods are the only methods which are worth considering, the expense of treatment by chemical methods being greater than can be supported by the value of the crop.

The use of chemicals in combating the ravages of insects had its origin so recently as 1870, when the Colorado beetle was threatening to wipe out the potato crops of the United States of America. The beetle spread rapidly Eastward from between the Mississippi River and the Rocky Mountains, and in a few years had reached the Atlantic Coast. The growing of potatoes was thought to be doomed, and famine was predicted. The suggestion was then mooted of poisoning the potato tops upon which the beetles fed. Paris Green was used for the purpose and proved to be effective. The insects ate the poisoned leaves and died, and the crops were saved. Since that day, and particularly during the last twelve or fifteen years, rapid strides have been made in the artificial control of injurious insects by chemical means, until at present the majority of insect pests attacking crops of considerable capital-value per acre are controlled by spraying, dusting, or fumigation.

If it is desired to kill the insects creating any particular pest, a stomach poison acting on the insect after feeding, a contact poison which kills the insect by contact with it, or a fumigant which suffocates the insect must be employed. The structure and habitat of the insect and the nature of the damage done by it determine which shall be used. If, on the other hand, it is wished only to prevent attack upon particular plants or in definite places, sprays, powders, or fumes are applied which are distasteful to the insect while not necessarily of a poisonous nature.

Stomach poisons are applied to the outside of the plant, or that portion of it upon which the insect feeds. They are then ingested with the food and cause death. They are not applied to the insect itself. It follows, therefore, that they are applicable only to those insects which chew and eat the leaves or tissues on the outside of the plant. A great many insects, however, do not obtain their food in this way. Some possess a beak which they insert into the plant, and through which they suck the plant juices. It is not possible to poison their food supply. To such insects, therefore,

the chemicals must be applied in such a way that the insect is killed by contact. The object usually aimed at is to cause death by suffocation, and for this purpose a fluid is sprayed which enters or chokes the breathing pores of the insect. Here the insecticide is applied to the insect itself, and only incidentally to the plant. This method is applicable to sucking insects of small size, as for instance green fly, scale insects, or thrips.

Fumigants consist of substances which produce a poisonous gas. As they kill by suffocation, they are effective against all kinds of insects, but they can only be applied in very special cases, where the attacked matter can be placed in a closed chamber. They are most used in fighting pests living in stored produce, such as the beetles infesting grain. The well-known method of treating White Ants with a smoking engine is a combination of the fumigant and the stomach poison.

Under mechanical measures will be considered all the methods which do not fall under the other three heads. Under it are included such devices as the collection of eggs by hand from plants or from the ground; the preparation of tempting places to which the females are attracted to lay their eggs, rendering collection unnecessary; setting light-traps to which the insects fly at night, to fall into kerosened water and die; or driving insects along between converging walls of sheeting to a bag-trap at the apex: a method familiar enough to those who have followed the locust campaign in Selangor or Negri Sembilan.

Stomach poisons will be considered in some detail next month.

NOTES FROM THE INDIA RUBBER JOURNAL SPECIAL PLANTATION NUMBER.

BY B. J. EATON.

STANDARDIZATION.

The special plantation number of the *India Rubber Journal* contains a few interesting notes by various members of the India Rubber World on different subjects, one of which on standardization by Mr. Whitby, Chemist to the Societé Financière etc., may be of interest to local planters, if it does no more than to indicate how much we have yet to learn concerning our premier agricultural product. The principal statements made by Whitby are given below and commented on by the writer.

Although the etymology of the word "standardization" and its misuse is discussed by Whitby, I think the idea is well understood by planters and others. No one, for example, would think of a single standard for all grades of plantation rubber, nor dream of mixing say a tacky sample of "earth" rubber with rubber from No. 1 latex to bring the crop to one standard, for this would be but a fetish or the essence of "red tape" methods. Similar remarks apply to the use and abuse of the word "uniformity" in its application to rubber. Some words in our language have acquired a double meaning and others are used somewhat loosely, even, or one might say, especially by scientific workers, whose writings are by no means gems of literature or noted for their clearness.

As I have stated elsewhere absolute uniformity is probably impossible of attainment and not essential. What is required is a knowledge of how each rubber behaves in respect to the treatment which it has to undergo after reaching the manufacturer. If two samples of rubber behave similarly when mixed in a certain manner and cured at a certain temperature for the optimum time, *i.e.* for the time which gives the best results on subsequently testing the vulcanised rubber, it would be logical to conclude that such rubbers would behave similarly, with respect to each other, when used in other mixings at other temperatures, *i.e.* it would cure fast or slowly, although even here analogy is dangerous and only experimental data should be allowed to decide the question. Different rubbers undoubtedly have different uses in manufacture.

As Whitby states, each rubber should be compared on the basis of the best results given. This possibly may have been done in some of the results published, but unfortunately this is not indicated in any way and in some instances I know that standard mixes, times of cure and temperature have been taken, principally to avoid the large amount of experimental work involved, by varying, say, the time of cure, especially in the initial researches. There is more than one factor however in connection with the optimum result which has to be considered. For instance, suppose two samples of rubber mixed similarly and cured at the same temperature gave equally good results on testing, one after curing for 2 hours and the other 2½ hours, the results being the optima; in the absence of further data with regard to curing, one would naturally prefer the sample which vulcanises in the shorter time in order to economise in steam and time in the factory. On the other hand a shorter or longer cure might have an effect on the durability of the sample which might invalidate this preferment and this can only be decided again by long experience. The

principal work in a testing laboratory in the consuming countries is to ascertain the behaviour on vulcanising of each rubber and to supply such information to prospective buyers. Manufacturers would no doubt be able to correlate their works' practice in accordance with the reports obtained. In the producing countries, our primary object must be to endeavour to make all rubber, of any particular type, from all estates—*e.g.* smoked sheet or first quality crepe, similar in character, that is, uniform in its behaviour on vulcanisation and secondly to make the standard as high as, or higher, if possible, than the best quality produced at present, even if this necessitates alteration of methods.

Whitby strongly supports the idea that any system of testing as adopted in Europe on behalf of manufacturing interests, should not make the investigation of the problem of variation in the producing countries in the East less essential, and with this the writer is in entire agreement.

Secondly we come to the question of sampling, frequently with other products, as with rubber, a difficult operation, since an examination of a small specimen, say 2 lbs. from 5 to 10 cases representing ½ ton of rubber, is useless and misleading, unless the sample represents the bulk. Whitby states that a half ton lot from an estate may possibly contain rubber coagulated by different amounts of acid, on different days, from latices of different degrees of dilution, obtained from different areas of trees of varying ages, planted differently and under different weather and soil conditions and different tapping systems, together with other variants such as time of standing of latex before and after coagulation, variation in machining, smoking etc. On the larger estates however, many of these variants, in so far as they are concerned with the latex after it leaves the trees, may be probably neglected, as on all properly controlled estates, the latex should be collected pure and diluted to a standard extent, so that a certain volume always yields the same quantity of dry rubber; the amount and dilution of the acid should be fixed, as should the coagulating time and amount of machining and period of smoking. As I have stated elsewhere, if the natural factors have to be considered as having an effect on the ultimate quality of rubber, by these I refer to soil, age of tree, distance of planting, weather conditions etc., then uniformity, even of one grade, becomes an impossibility, unless some system be adopted in the preparation of rubber by which one lot of rubber is made over a period, say a fortnight or month or any period which is found to give a satisfactory average of daily variations due to natural conditions. I have indicated one such process in a previous

publication and in a paper sent to the Congress of Tropical Agriculture, London 1914. In my own opinion however, these natural factors affect quantity of latex rather than quality, although personal opinions must not be allowed to weigh against experimental data—unless the latter are wanting, as they are to a large extent at the present time.

Whitby's reference to the "not inconsiderable number of estates on which each coolie's latex is coagulated separately" should not be used as an argument in dealing with the problem, since any estates working on such lines deserve, at the present time, to fetch low prices for non-uniform rubber, as with a little extra labour and trouble, such a system could be dispensed with, by measuring or weighing the latex and coagulating separately a small aliquot portion for the purposes of payment on contract and bulking the remainder. There appears to be no reason why any estate should not be able to manufacture uniform rubber of any particular type, day by day, from first quality latex, unless the natural factors mentioned above cause daily variations. (Rain during or just before tapping must always be excepted.)

In dealing with the Brazilian method of curing latex and the various imitations which have been suggested or adopted for dealing with large quantities of plantation latex, most writers appear to have missed, what appears to me to be an important feature of the problem of uniformity.

It must be remembered that, at present, in discussing this question, one has to take for granted the statements of various manufacturers as to the uniformity of Brazilian "Fine Hard Para" when compared with the variability of plantation rubber, and by the term "uniformity" is probably meant behaviour on vulcanising, rather than absolute uniformity in tensile properties, although uniformity in both respects should be a feature in Fine Hard Para. The manufacturers' "uniformity" refers probably chiefly to "rate of cure," that is, in order to get the best results with "Fine Hard Para" the manufacturer knows by experience that for any particular "mix" or class of goods he can always cure his rubber, for the same period whereas with plantation rubber he has to ascertain this period experimentally for each case or lot, if he is the fortunate possessor of a testing laboratory, involving further cost and possibly delay, unless, as is done apparently on the market, he buys certain estate marks or brands, the qualities of which he knows by experience to be constant.

On the assumption then that Fine Hard Para is constant in this respect, what constitutes or causes this uniformity, especially

when we remember that the latex is affected by quite a number, if not all the natural variants mentioned above in the case of plantation rubber? The obvious reason is in the law of averages, and is due not necessarily to any intrinsic valuable property in the Brazilian method of smoking, but to the fact that the slowness of this method enables a single ball, cylinder or block of "Fine Hard Para" to be made up during a period of weeks or months, rather than daily, so that daily variations are corrected or averaged. Any process therefore which is an imitation of the Brazilian process, but made to act more rapidly, in order to deal with the latex collected on one day only, defeats the purpose of the process in this respect, unless the rubber made on the particular machine on one day is left on the machine and super-imposed by rubber made on the next day and for days after, since the daily variations would otherwise still be present in each separate lot.

The above opinion is based naturally on an assumption viz. that Fine Hard Para is uniform, as stated so often by manufacturers, but it still holds good if the uniformity is not absolute, but is better than that of plantation rubber of any one type from first quality latex. (Lower grades must obviously be left out of the discussion and dealt with separately.) The problem can be attacked in this country by an exact imitation of the Brazilian method with plantation latex and a strict comparison with similar latex converted into smoked sheet or other forms, except that it probably requires some amount of experience and manual skill in smoking, to obtain a "Hard Cure" sample with the same quantities of water in the rubber. The tendency on the part of the non-expert as opposed to the seringueiro in making "Hard Cure" is to use too much heat or too prolonged a drying period for each film of latex.

The process described by the writer in the publications referred to above, is one which enables latex to be smoked and slab prepared from superimposed layers of latex over any period desired within limits depending on commercial considerations, say period of one to four weeks. The writer is at present investigating the vulcanising properties of rubber prepared in this way. The rubber made in this way, if put on the market in the original form, would certainly have neither appearance nor odour to recommend it (the odour is not putrid but is peculiar) although, since it would have to be creped and dried by the manufacturer before use, there is no reason why the crepeing and drying should not be done on the estate, provided machining is kept as uniform as possible.

After this digression, a final reference to Whitby's note must be made, with regard to his timely plea for the publication of all

research in this subject in a scientific way, that is, in such a way, that criticism is invited and can be made, of the methods used and the results arrived at. It is quite easy to draw deductions from one's own methods and results, which may not be drawn by others; faulty methods of experiment may give results which prove certain facts, which would be contrary under other conditions of experiment. Even in scientific work the "scientific" spectator may see more of the game and criticism is vital to all scientific work, in fact it is a stimulus to all work. Unfortunately it is generally sadly lacking in the East in more than one line of work, and because "Jones" says it is so, it must be so, because there is no other to negative the statement. There is need also, to emphasize Whitby's remarks on the slowness of the work and the fact that pecuniary profit is not always very immediate. Unless drastic reforms are introduced or some miracle worked by the researcher,—and the cry is still "Shew us a miracle,"—the slow evolution of an industry brought about by the adoption of scientific methods—there is nothing of magic in the word—is apt to be overlooked, and the evolution considered to be merely what would have happened in any case.

The investigation of cause, and the observation of effect must go hand in hand—the reason why must always be ascertained, although the planter, in this case, is interested principally in the effect.

It is in one respect a pity, that there is not more co-operation among the workers on this problem in the East and elsewhere; on the other hand rivalry, provided it remains healthy rivalry, is stimulating, and, although overlapping may occur, this is not altogether a disadvantage, since independent confirmation is valuable, as are contrary results by different workers, as they prevent incorrect dogmas and lead to further investigation and to the discovery of further factors which may have caused the discrepancies in results.

What is required however, and the time is certainly ripe for this, as I am inclined to think that few of us have any real secrets, and if we have, these secrets may still be kept, is that all such work should be published or at any rate available among the workers in the subject.

It is hoped to publish a prelimary paper next year on the investigations at the Agricultural Department and the methods employed, as well as the results obtained, will be given in full, in order to invite criticism especially from other investigators who are in a position, by reason of their own work, to criticise. As

Whitby states, the problem is decidedly complicated and the practice by no means as simple as it appears, owing to the difficulty of avoiding disturbing factors in the treatment to which the rubber is subjected during manufacture as well as in the preparation from latex to raw rubber.

A really live and active International Committee or at least a British Committee is required in connection with the investigation of vulcanisation methods, so that, as far as possible, work may be carried on at different centres, on similar lines and be capable of correlation. Such a committee was formed several years ago, but its activity has been, so far, conspicuous by its absence. I understand from a Dutch colleague that this committee may be reorganised with a permanent paid secretary, if the necessary funds can be found and arrangements can be made between the countries principally concerned.

With all due deference, an exception must be taken to Whitby's statement on "the method of testing which we owe to Dr. Schridowitz."

Although Whitby may have been carrying out experiments with Schridowitz and is therefore aware of the methods employed, these methods have not so far been published and the only mention made concerning this work is contained in the report of the Committee appointed by the Rubber Growers' Association in connection with a proposed scheme for a testing station in England, in which several rubber works' chemists and other technical experts stated that after examining the methods (which were not given in the report) used by Schridowitz they considered them of practical value and capable of being correlated with works' practice.

Some time ago Schridowitz stated that these methods would be published shortly, but they have not yet appeared in any of the well-known technical journals. After carrying out a number of prelimary experiments at the Agricultural Department it was soon found that it was not satisfactory to vulcanise on one standard only, since rubbers differently prepared vulcanise at different rates.

There are two methods which then present themselves for purposes of investigation viz. variation of time of cure or variation of temperature and of these the former appears the more suitable. Each sample is therefore vulcanised with a fixed proportion of sulphur (10 per cent) and at a standard temperature 140°C (equivalent to a steam pressure of 40 lbs. per sq. inch.) for varying periods. From some results already obtained by Mr. Grantham and the writer it appears probable that from one or two preliminary cures on each sample it may be possible to predict the

correct rate of cure of the sample, thus saving the time involved by carrying out a long series of cures to ascertain this point in each case.

PRELIMINARY LIST OF INSECTS COLLECTED IN THE FEDERATED MALAY STATES.

BY C. B. HOLMAN HUNT.

(*Continued*)

The uncommon species are marked with an asterisk.

ANTHRIBIDAE.

Litocerus sp (a)		Plains.
,, sp (b)		Plains.

CURCULIONIDAE.

Apoderus nr echinatus. Gill		Plains.
Euscelus bispinosus.	Batu Tiga, Selangor.	Plains.
Apion sp.		Plains.
Cylas formicarius. Fab.	(Sweet Potato Weevil.)	Plains.
Hypomeces squamosus. Fab.	Kuala Lumpur, Selangor.	Plains.
Geotragus inflatus. Tekel.	Bukit Kutu, Selangor.	3300 feet.
Episomus chlorostigma. Wied	Batu Caves, Selangor.	Plains.
Phytoscaphus triangularis. Oliv.		Plains.
Phytoscaphus nr triangularis. Oliv.	Gap, Selangor-Pahang.	2700 feet.
Alcides nr crassus. Pasc.	Batu Tiga, Selangor.	Plains.
Alcides discedens. Pasc.	Batu Tiga, Selangor.	Plains.
Camptorhinus nr pilipes. Fab.		Plains.
Mecocorynus sp (a)	Gap, Selangor-Pahang.	2700 feet.
Mecocorynus sp (b)	Gap, Selangor-Pahang.	2700 feet.
Rhynchophorus ferrugineus. Oliv.	(Pest on Coconuts)	Plains.
Sphenocorynus cinereus. Illig.	Batu Tiga, Selangor.	Plains.
Sphenophorus de hanni. Gylb.	Batu Tiga, Selangor.	Plains.
Sipalus granulatus. Fab.	Gap, Selangor-Pahang.	2700 feet.
Calandra stigmaticollis. Gylb.		Plains.
Cercidocerus sp.		Plains.
Mecistoceros sp.		Plains.
Acicnemis sp.	Gap, Selangor-Pahang.	2700 feet.

SCOLYTIDAE.

Platypus cupulatus.	(In dry timber.)	Plains.

BRENTHIDAE.

Carobates tristriatus. Lund.		Plains.

BOSTRICHIDAE.

Xyleborus perforans.	(Shot hole borers.)	Plains.
Xyleborus parvulus.	(Shot hole borers.)	Plains.

End of Coleoptera.

The above list does not include a large number of common forms, but these are being worked at locally and it is hoped to bring out an appendix to the list of Coleoptera shortly.

The list of Moths identified is also being arranged but owing to other work there may be some delay in bringing this out.

(*To be continued.*)

DEPARTMENT NOTES.

Mr. F. T. Brooks, Mycologist Department of Agriculture, F. M. S. left the Department on 30th November, 1914 on the expiration of his agreement.

Mr. F. G. Spring, Agriculturist, Department of Agriculture, F. M. S. proceeds on 8 months' leave on 10th December, 1914.

FEDERATED MALAY STATES.

Comparative Statement of Cultivated Rubber Exported, with Value and Duty Collected Thereon, During the Years 1914 and 1913.

Destination.	Exported during October, 1914.	Previously.	Total export during the year.	Export during similar period of previous year.	Increase.	Decrease.	Value of rubber exported, 1914.	Duty collected, 1914, to date.
	Tons.	Tons	Tons.	Tons.	Tons.	Tons.	$	$ c.
Straits Settlements	1,725.85	*12,672.58	14,398.43	8,544.99	5,853.44	...	23,119,315	
United Kingdom ...	1,122.14	7,434.34	8,556.48	8,620.63	...	64.15	16,801,086	
Continent of Europe ..	...	807.78	807.78	1,125.01	...	317.23	1,437,762	
Ceylon	48.57	535.63	584.20	497.80	86.40	...	819,725	
Other Countries ...	...	100.27	100.27	...	100.27	...	413,498	
Total ..	2,896.56	21,550.60	24,447.16	18,788.43	6,040.11	381.38	42,591,386	999,914 49

*NOTE.—The previous monthly return showed a total for the year up to end of September of 12,696.41 tons. This was found to be wrong, owing to one lot being included twice over.

KUALA LUMPUR,
7th November, 1914.

H. W. FIRMSTONE,
Acting Commissioner, Trade and Customs, F.M.S.

Abstract of Meteorological Readings in the various Districts of Malaya for the Month of October, 1914.

DISTRICT.	Mean Barometrical Pressure at 32° Fah.	Maximum in Sun.	TEMPERATURE.				HYGROMETER.				Prevailing Direction of Winds.	Total Rainfall.	Greatest Rainfall during 24 hours.
			Mean Dry Bulb.	Maximum.	Minimum.	Range.	Mean Wet Bulb.	Vapour Tension.	Dew Point.	Humidity.			
Kelantan, Kota Bahru	...	149.	81.4	90.	73.87	16.13	77.8	.880	75.4	82%	...	8.59	2.27
Malacca, Durian Daun Hos.	29.797	150.2	83.	87.5	71.7	15 8	79.7	.966	...	86	N.	3 62	I.34
N. Sembilan, Dist. Hospital Seremban	...	151.2	78.5	87.6	71.6	16.	75.5	.828	73.4	84	N.W.	17.27	4.01
„ Dist. Hos. K. Pilah	...	151.8	80.1	88.9	72.6	16.3	76.6	.849	74.2	82	...	13.02	2 93
„ „ Tampin	...	144.4	81.8	91.	73.	18.	76.5	.815	73.	75	...	11.50	2.40
„ „ P. Dickson	...	138.8	82.4	87.7	74.4	13.3	77.4	.846	74.1	76	...	4.89	1.75
Pahang, „ K. Lipis	...	...	80.9	89.2	70.9	18 3	75.8	...	...	...	...	11.58	2.65
Penang, „ Penang	29.871	141.	82.2	88.8	73 2	15.6	77.7	.886	74.8	82	...	13.96	3.20
Perak, „ Taiping	...	105.	80.13	94.	70.	24.	76.77	.876	...	87	...	39.42	3.53
„ „ Ipoh	...	...	81.36	92.	70.	22.	76.62	.854	...	80	...	12.45	1.98
„ „ T. Anson	...	...	81.59	91.	71.	20.	77.06	.868	...	81	...	24.00	4.37
„ „ P. Buntar	...	...	81.52	92.	72.	20.	76.29	.835	...	78	...	20.42	2.56
„ The Cottage	...	...	...	...	...	...	...	...	...	...	...	32.11	4.00
Selangor, General Hospital Kuala Lumpur	...	144.2	80.4	88.8	61.2	27.6	77.0	.862	74.7	83	S.W.	17.82	2.42
„ Dist. Hos. Klang	...	...	80.1	87.7	73.7	14.	78.2	...	...	...	...	15.23	2.18
„ „ K. Selangor	...	...	...	88.	75.	13.	...	...	...	...	...	15.61	2.96
„ „ Rawang	...	...	...	90.3	72.	18.3	...	...	...	...	...	11.32	2.45
Singapore, Kandang Kerbau Observatory	29.859	157.4	83.9	89.1	75.	14.1	78.	.875	...	76		2.17	1.46